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ABSTRACT

This report results from an evaluation of the National Research Foundation's Graduate Research Fellowship program. The study sought to determine: (1) whether NSF fellows show evidence of more timely degree completion and early career success; (2) whether graduate fellows and minority graduate fellows experience similar education and career success; and (3) whether the individual award aspect of the program enhanced the educational experience and career options of fellows. A 52-item survey questionnaire measured attendance patterns, completion rates, and time to degree of 9,035 NSF fellows who received first-year awards between 1979 and 1993. The study found positive effects on all three dimensions for female fellows and for recipients of minority graduate fellowships, suggesting a "signaling" effect both for individuals and their departments. The importance of the individual award aspect of the fellowships varied by discipline and by other sources of graduate funding support available in individual departments. Appended are seven data tables and illustrative graphics. (Contains 17 references.) (CH)

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ED 437 007

Fellowship Effects in Graduate Education:

Evaluating the Impact of the National Science Foundation's Graduate Research Fellowship Program[1]

Sharon S. Goldsmith and Jennifer B. Presley

ABSTRACT

NSF Graduate Research Fellowships support graduate education in science, mathematics and engineering (SMET). Using multiple data sources, this evaluation of the GRF program reveals advantages of fellowship support and disciplinary variation in fellowship impact.

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This paper was presented at the annual meeting of the Association for the Study of Higher Education held in San Antonio, Texas, November 18-21, 1999. This paper was reviewed by ASHE and was judged to be of high quality and of interest to others concerned with higher education. It has therefore been selected to be included in the ERIC collection of ASHE conference papers.

INTRODUCTION

Since 1952 the National Science Foundation (NSF) has awarded Graduate Research Fellowships (GRF) to individuals for graduate study. It is the largest single fellowship program in the country, supporting approximately 1000 new NSF fellows each year. GRF awards are made to aspiring research scientists and engineers through a merit review process based on an evaluation of each applicant's abilities as demonstrated by academic records, recommendations, and Graduate Record Examination scores. Awards are made for three years and are portable, enabling recipients to enroll in the program of their choice. Between 1978 and 1998, the NSF fellowships were awarded in two competitions - Graduate Fellowship (GF) and the Minority Graduate Fellowship (MGF). This latter competition was eliminated in 1998 in response to a lawsuit. By 1993, 43% of new NSF fellows were women. That year in the GF program new fellows were 10% each Asian/Pacific Islander or Hispanic, 6% African American, and 2% Native American. In the MGF program, 48% of fellows were Hispanic, 36% were African American and 8% each were Native American or Asian/Pacific Islander. Fellowship support is intended to enhance a student's opportunity to define a research topic, complete a degree quickly, and lead to successful entry into research careers.

PRIOR STUDIES

Four studies of NSF fellows conducted by the National Research Council (NRC) have looked at GRF program outcomes (Harmon, 1977; Snyder, 1988; Baker, 1994, 1995). Outcome indicators have included completion rates, time to degree, subsequent academic appointments, success in obtaining research grants, and, in the 1977 study, publications and citations. The Snyder and Baker studies used applicants for GRF judged qualified but not awarded fellowships as a comparison group (Quality Group 2 non-awardees). These studies confirmed that students supported by the GRF are well qualified, attend outstanding graduate programs, are more likely to complete doctorates than non-awardees, and are likely to become successful scientists. However, the last cohort of NSF fellows to be included in an analysis of outcomes was 1981 fellows, and both the science and engineering environment and the university context for graduate education have changed dramatically since that time.

THE STUDY

PURPOSE OF THE CURRENT STUDY

In 1998, NSF contracted with WestEd to undertake a program evaluation of the Graduate Research Fellowship program. The interim evaluation report was provided to NSF in the summer of 1999 (Goldsmith, Presley and Cooley, 1999). In this paper, we will address three of the overarching research questions of the study:

1. Do recent NSF fellows show evidence of more timely completion of degree and early career success?
2. Do GF and MGF fellows experience similar educational and career success?
3. Does the individual award aspect of the NSF Graduate Research Fellowship enhance the educational experience and career options of fellows?

The study design built on the strengths of prior GRF studies that used existing data sources but for the first time sought to address broader issues of program impact through a multi-methods approach to the evaluation. There were three interrelated components to the study:

- extending outcomes information for three five-year cohorts from 1979 to 1993 using the Survey of Earned Doctorates and NSF's Cumulative Index[2];
- designing and administering a questionnaire sent to more than 1400 NSF fellows and a comparison group of non-NSF fellows in selected disciplines (1989-1993 cohort); and
- 149 interviews conducted with graduate students and 75 interviews with faculty, staff, and administrators during site visits at 6 research universities.

RELEVANCE OF THE STUDY

Funding Graduate Education

While there is no debate that financial support benefits graduate student completion rates, there remain serious policy questions nationally about the best ways to fund graduate education

[2]The Cumulative Index of NSF Fellowship Applicants and Awardees contains information on all applications to the NSF GRF program, including applicant demographics, educational data, test scores, and fellowship status.

(Federation of Societies for Experimental Biology, 1997; Nettles, 1990a; Wagner, 1992; Bowen and Rudenstine, 1992). Research assistants assist faculty with sponsored research; teaching assistants help institutions to meet instructional commitments; and program assistants contribute to administrative needs. Training grants enhance programmatic aspects of graduate education, and the report of the Committee on Science, Engineering and Public Policy (COSEPUP) (NAS, 1995) recommended adjusting support mechanisms to include new education/training grants to institutions and departments. Only fellowships are designed solely to benefit the graduate student recipient, and yet concerns have been raised that this form of funding may lead to student isolation from peers and faculty.

For NSF, the GRF program has been the major instrument for directly funding graduate students, and the program now costs over $60 million each year. Graduate students also are funded by NSF as research assistants through the agency's support of sponsored research. Furthermore, NSF has recently initiated graduate training grants awarded to institutions. Finally, Federal agencies, including NSF, are under pressure to demonstrate the effectiveness of their programs under the Government Performance and Results Act (GPRA) of 1993, increasing the need to understand what is working and what is not when funding graduate education.

Current Research

A number of studies have examined the distribution of financial aid at the graduate level (Hauptman, 1986; Educational Testing Service, 1987; Nettles, 1990b; Millet & MacKenzie, 1995; Rapoport, 1999), but there are relatively few that have examined empirically the impact of fellowship funding on graduate school success, especially in comparison to other modes of support. Bowen and Rudenstine (1992) compared student outcomes (completion and time to degree) of several national fellowship programs and concluded that fellowships enhance time to degree but not completion rates. Ehrenberg and Marvos (1996), in contrast, found that financial support patterns at Cornell had their strongest impact on program completion and influenced time to degree much less. Smith, Wolf and Busenberg (1996), in a study of Ford Minority fellows, Mellon Fellows and some Spencer Fellows, noted the important networking links provided by fellowships. The earlier studies of NSF's GRF program found that more NSF fellows than non-awardees completed doctorates and that they did so in a shorter amount of time (Harmon, 1977, Snyder, 1988, Baker, 1994, 1995).

Our study extends this body of work in the following ways:

- It extends analysis of the NSF national fellowship data set to 1993 recipients.
- It is not limited to findings from one or a few institutions.
- It includes primary data (survey and site visits) to complement secondary data analysis.
- It covers a period when (a) the proportion of female fellows increased (from 29% in 1979 to 43% in 1993), and (b) the MGRF competition was in place. This allows us to examine differences in fellowship impact by gender and race/ethnicity.
- It includes for the first time a comparison group of non-NSF funded peers who may not have applied for GRF funding.
- It includes non-completers and those still enrolled in addition to completed Ph.D.s.
- It addresses difficult methodological issues of identifying and locating former students.
- It begins to assess differences in impact of fellowships and training grant support, in addition to traditional graduate assistantships (RA, TA, PA).

METHODOLOGY

Survey of Earned Doctorates (SED) Analysis

We matched the Cumulative Index (CI) to NSF's Survey of Earned Doctorates through 1997 (the latest year available) to measure attendance patterns, completion rates, and time to degree of 9035 NSF fellows who received first-year awards between 1979 and 1993. Since the Minority Graduate Fellows competition began full implementation in 1979, starting with that year allows a nearly complete analysis of MGF fellows through 1993. Program quality rankings were obtained from the National Research Council's most recent study of doctoral programs (National Research Council, 1995). As in prior studies, we compared the performance of NSF fellows to non-awardees in the Quality Group 2 category (N=3308). We examined differences by discipline grouping, gender and GF/MGF competitions.

The Graduate Student Follow-up Survey

A 52-item survey questionnaire was designed to collect information on the graduate education experience and early career paths of NSF fellows and program peers (1989-1993 entering cohort) who did not receive NSF GRF funding. The cohorts of NSF fellows and program peers who entered their graduate programs between 1989 and 1993 are currently passing through the transition from graduate school to postdoctoral study and employment. We included those who

did not complete graduate programs to discover the reasons for not completing degrees and to gather information on their career paths. The instrument and survey methodology received OMB approval in December 1998.

We administered the Graduate Student Follow-up Survey to three samples, each responding to specific issues to be addressed in the GRF evaluation.

- The Disciplinary Sample: NSF fellows (termed "Disciplinary fellows" in this paper) and a comparison group of program peers in four disciplines at 16 institutions who entered the same programs from 1989 to 1993 (N=1131)
- Minority Graduate Fellows Sample: To increase responses from NSF fellows from underrepresented groups, we also administered the same Graduate Student Follow-up Survey to 200 MGF recipients (a 35% sample randomly selected from the CI), regardless of discipline or institution enrolled in. The MGF sample included fellows in 33 disciplines at 62 institutions.
- Women in Engineering Sample: We also surveyed 50% of all Women in Engineering (WENG) fellows who received their awards between 1990, when the program was initiated, and 1993. Again they were randomly selected from the CI (N=143).

The Disciplinary Sample. The Snyder (1988) and Baker (1994, 1995) studies used Quality Group 2 non-awardees as the comparison group, as did we for the SED analysis. The strength of this approach is that those in the comparison group survived the fellowship review process. Having done so, the Quality Group 2 non-awardees were considered comparable to fellows not only using such measures as Graduate Record Examination (GRE) scores but also with regard to their ability to write a strong research essay and the strength of personal recommendations. However, this comparison group is also limited to individuals who applied for an NSF graduate fellowship. Furthermore, QG2 non-awardees are not necessarily enrolled in the same graduate programs as the NSF fellows, allowing institutional effects to intrude into the design. Ideally, a random sample of graduate students who were similar to GRF awardees in all respects except for having been awarded an NSF fellowship would be created. However, no database had existed from which to draw such a sample.

We identified a database that allowed the selection of a comparison group that is not limited to NSF applicants. Since 1989, the American Association of Universities (AAU) and the

Association of Graduate Schools (AGS) have been working with the Educational Testing Service (ETS) on a database on doctoral students. The AAU/AGS Doctoral Education Database contains data on doctoral students since 1989 from 40 institutions in four NSF disciplines: Biochemistry, Economics, Mathematics, and Mechanical Engineering. We used the database to identify peers entering the same graduate programs as NSF fellows.

We administered the Graduate Student Follow-up Survey to all NSF fellows and a sample of twice the number of their program peers in the disciplines of Biochemistry, Economics, Mathematics, and Mechanical Engineering at 16 institutions (N=1131).[3] The "program peers" comparison group was drawn from students who began the same graduate programs at the same time as the NSF fellows but who did not receive (and may not have applied for) an NSF GRF. The 16 institutions included 15 participants in the AAU/AGS database that was used to sample the program peers and one non-participating institution with a large number of NSF fellows that agreed to provide comparable data and a program peer sample. We only included institutions that had at least two NSF fellows in the database who entered the four disciplines from 1989-1993. Because of the concentration of NSF fellows by field in a few institutions, we estimate that we included in the survey approximately 61% of 1989-1993 fellows in Biochemistry, 81% of fellows in Economics, 62% of fellows in Mathematics, and 71% of fellows in Mechanical Engineering.

Locating Survey Recipients. Locating survey recipients proved to be a very difficult task. NSF does not track former fellows and had no follow-up addresses. So we began by requesting current addresses from the institutions in which fellows (all three samples) and program peers had been enrolled. Although most institutions provided mailing addresses to us, many of these were no longer valid. We sent two postcard follow ups to individuals whose questionnaires were not returned either completed or as undeliverable. We hired a private investigation firm to further search for current addresses. Again, addresses were not found for some people, and for others, surveys were returned as undeliverable. We calculated our response rates on a base that discounts surveys that were undeliverable. This provides a very conservative response rate since it is highly likely that others did not receive surveys, even though those surveys were not returned as undeliverable.

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[3] In some cases, the total number of program peers was less that twice the number of GRF fellows.

Table 1
Survey Response Rates

	Number in sample	Percent of surveys undeliverable	Percent of 'deliverable' surveys completed	Number of respondents
Disciplinary Fellows	402	10%	48%	173
Disciplinary Peers	729	19%	29%	173
MGF Fellows	200	11%	40%	71
WENG Fellows	143	10%	59%	75

There was some overlap of individuals among the samples, and the analysis was conducted by sample. We also took care when looking at findings across samples because of the significant disciplinary and institutional differences in the samples.

Institutional Site Visits

We conducted site visits at six major research universities that are identified as Institutions A-F in this paper[4]. Four of these universities enroll very large numbers of NSF fellows, and the other two were selected for institutional and geographical balance. The six institutions included two private and four public universities located in the Northeast (1), Southeast (1), Midwest (1) and on the West Coast (3). The two private institutions enroll more graduate students than undergraduate students, and the six universities range in total enrollment from 10,000 to 40,000. These universities currently enroll between 38 and 293 NSF fellows in all programs and a total of 962 NSF fellows. Five of the six universities visited were also included in the survey for the Disciplinary sample.

[4] In this paper, site visit institutions are referred to as Institution A through F. References to other institutions will read Institution X. To reference quotations from site visit reports, disciplines are abbreviated as BIO for Biochemistry, EC for Economics, M for Mathematics and ME for Mechanical Engineering. Quotations from the survey are identified as either peer or fellow, sometimes with additional information on the respondent such as gender, race, or ethnicity.

Two-person teams conducted interviews over a two- to four-day period at each institution. Interview protocols received OMB approval in December 1998. In addition to administrators and staff responsible for graduate studies and fellowships across the university, we interviewed faculty, staff, and students in 19 departments that correspond to the 4 disciplines selected for the survey of fellows and program peers: Biochemistry (5), Economics (3), Mathematics (6), and Mechanical Engineering (5). Teams created site reports for each institution that were combined in Hyperqual2, a qualitative data analysis program (Padilla, 1993). The data was then sorted using a coding plan to identify patterns and issues for analysis.

At the six institutions, we interviewed 75 administrators, faculty, and staff. We interviewed 149 students (73 NSF fellows and 76 peers). Only one student interviewed (a peer) indicated having a disability. There was more gender balance among the NSF fellows interviewed. Although only 5.5% of NSF fellows and 6.6% of peers interviewed were Hispanic, the NSF fellows were more racially diverse. Since only U. S. citizens and Permanent Residents are eligible for the GRF, there were no international students among NSF fellows; however, 14% of the peers interviewed were international students . Most of the NSF fellows and peers interviewed were in the second through fourth year of their graduate program.

FINDINGS AND IMPLICATIONS FOR RESEARCH AND PRACTICE

Do Recent NSF Fellows Show Evidence Of More Timely Completion Of Degree And Early Career Success?

Doctoral Program Completion Rates

For a definitive comparison of completion rates, we needed a large group of non-fellows to compare with fellows. As in past studies (Snyder, 1988; Baker, 1994, 1995) we used Quality Group 2 (QG2) non-awardees because they were assessed in the application process to be equivalently qualified as QG2 awardees. We used the Survey of Earned Doctorates (SED) through the most recent year available (1997) to look at completion rates for 9035 fellows and 3380 QG2 non-awardees.

We used nine-year completion rates for the two five-year cohorts of fellows (1979-1983; 1984-1988) because these maximize our ability to compare groups over time using the most recent SED data (1997). In order to include the more recent 1989-1993 cohort, who has had between four

and eight years to complete, we also compared four-year completion rates for all three cohorts (Table 2).

Table 2
Doctoral Completion Rates for GRF Fellows

Five Year Cohort	Percent completing Ph.D. in 4 years or less	Percent completing Ph.D. in 9 years or less
1979-1983	11%	64%
1984-1988	9%	68%
1989-1993	6%	Not Applicable

The percentage of fellows completing in four years or fewer is going down, but the nine-year completion rate is increasing. The lower four-year completion rate of the recent 1989-1993 cohort does not necessarily foreshadow lower completion at the six-year or nine-year mark.

Completion Rates of Fellows and Non-Fellows over Time

Comparing fellow and non-fellow completion rates allows us to look for 'fellowship effects' – do graduate students with similar backgrounds have differential completion rates depending on whether they were NSF fellows or not? From Figures 1 and 2 we can see that the answer is Yes. QG1 fellows are most likely to complete doctorates, and this has not changed over time. Further, and most importantly for our research question, QG2 fellows are more likely to complete doctorates than QG2 non-fellows after nine years, but at the four-year mark, completion rates are similar for both QG2 groups. Across all disciplines, nine-year completion rates have risen from 67% to 70% for QG1 fellows and from 62% to 65% for QG2 fellows. Nine-year completion rates for QG2 non-awardees have remained the same (57.4% and 57.5% between the two cohorts.

Figure 1
Four-Year Doctoral Completion Rates

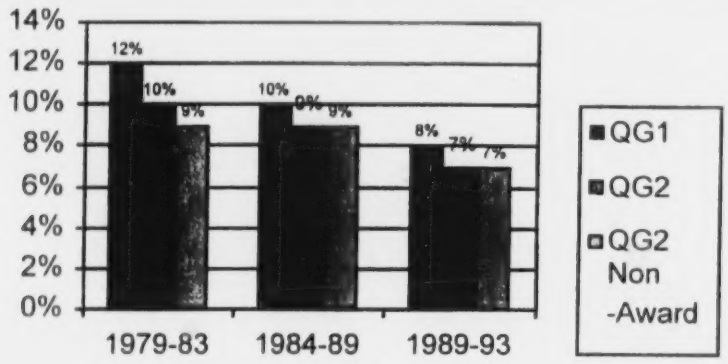
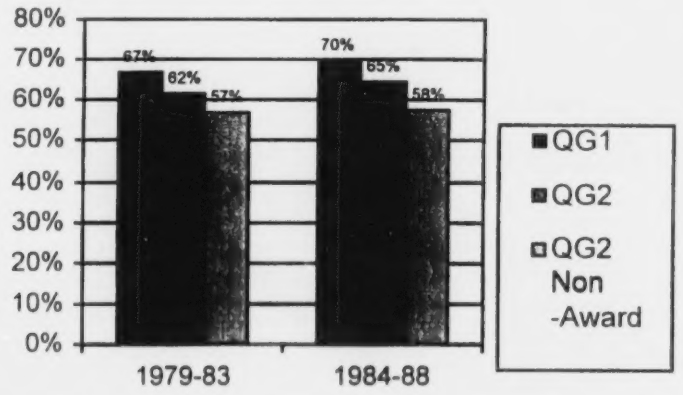


Figure 2
Nine Year Doctoral Completion Rates



Disciplinary Differences in Completion Rates by Quality Grouping

For all GRF QG1 fellows, nine-year doctoral completion rates have increased in all discipline areas except for Engineering/Math/Physical Sciences, where the completion dropped slightly (to 69% from 71%) between the 1979-1983 cohort and the 1984-1988 cohorts (Table A.1).

Nine-year completion rates for QG1 fellows in the Biological and Life Sciences rose from 68% to 75% between the 1979-83 and 1984-88 cohorts. For Behavioral and Social Sciences, the proportion of QG1 fellows completing within 9 years increased from 58% to 62%. For QG2 fellows, completion rates have risen in each discipline area. For QG2 non-awardees, on the other hand, completion rates in nine years dropped for those in Engineering/Math/Physical Sciences as

well as Behavioral and Social Sciences. There continues to be a fellowship effect for QG2 fellows versus QG2 non-awardees by discipline grouping.

Completion Rates by Gender over Time

Doctoral completion rates for women fellows are now only slightly lower than for men (Table A.2). Completion rates for 1984-1988 women fellows in most discipline areas are within ±4 percentage points of those for men. The largest discrepancy is in Social Science fields, where just 46% of women had completed doctorates in nine years, compared to 58% of men who had done so. Women fellows' doctoral completion rates are also lower in this discipline than they are in any other discipline area. Importantly, the distinction between NSF fellows and non-fellows is greater for women than it is for men, with 70% and 66% of QG1 and QG2 fellows graduating, compared to 55% of QG2 non-awardees, and 37% of fellowship decliners. (Table A.3) The GRF award seems to provide a particular advantage to women fellows in moving to doctoral completion.

Time To Degree

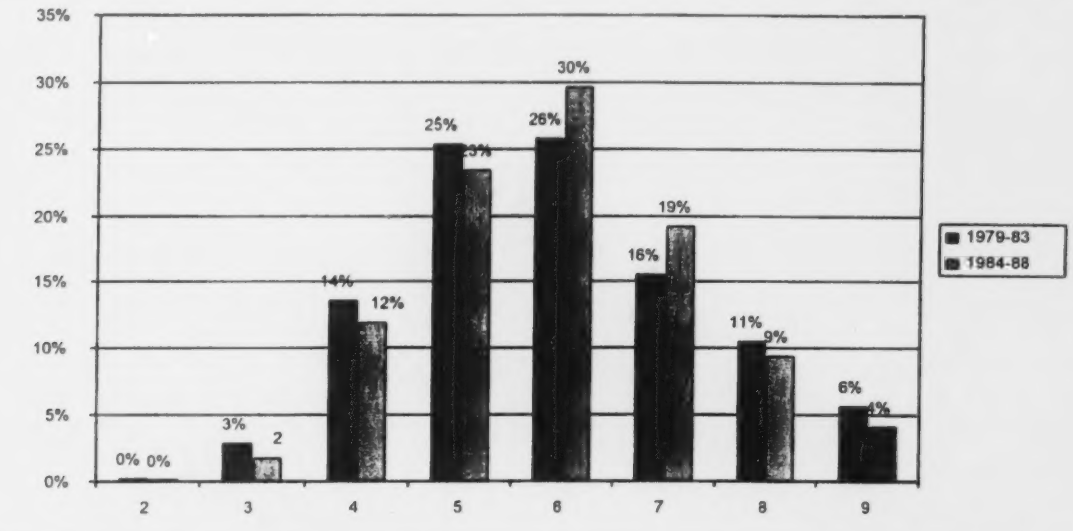
The length of time it takes for doctoral students to complete their programs, time to degree (TTD) is a commonly accepted and long-standing measure of success. It is of limited value when looking at trends, however, because it measures elapsed time from first enrollment in graduate school to receipt of the doctoral degree, rather than number of years enrolled. Many graduate students do not proceed directly to completion but may stop out temporarily before returning to finish. This persistence over time will affect the patterns of years to completion and increased completion rates will likely result in increases in TTD .

In this study, we measured the number of fellows who had completed their doctorates within a nine-year period from the time they first enrolled in graduate school, and we did so for two cohorts of GRF fellows - those who initially enrolled between 1979-1983, and those who first enrolled between 1984-1988 - in order to determine any apparent trends in TTD between earlier and more recent fellows (Figure 3).

Time to degree is converging around six years. The percentage (roughly two-thirds) of fellows in each cohort who completed their doctorates in six years or less is roughly the same for the two cohorts (67% and 68%). But the modal number of years shifted clearly to six for the 1984-1988 group, compared to being evenly spread between five and six years for the earlier cohort.

Furthermore, the tails of the distribution are shorter for later group—smaller proportions completed in four years (14% compared to 17%) but smaller proportions also completed in eight or nine years (14% compared to 17%). So is time to degree going up for GRF fellows? The answer is "yes" and "no," depending on the time lens brought to the observation.

Figure 3
Years to Doctorate for GRF Fellows Completing in Nine Years



TTD also varies by discipline. For the 1984-1988 cohort of NSF fellows completing doctorates in nine years, those in Engineering/Mathematics/Physical Science finished fastest (73% in six years or fewer), followed by Behavioral/Social Sciences (62%), and the Biological/Life Sciences (61%).

For the programs we visited, faculty and student estimates of TTD ranged from five to six years, with only one program indicating an average of four years for completion (Institution C-EC). Some NSF fellows believe that they will finish in less time because of the GRF, while others indicate that they choose more coursework or research time over speedy completion. In most programs, NSF fellows do not complete in less time, although some faculty speculated that they might.

> Given that GRF fellows would be freed up from having to TA or RA every quarter, one faculty member commented, "if students take advantage of it, they should finish faster." The Chair was even more emphatic: "They spend on average one year less

in the teaching rotation, and that translates to getting done six months faster." (A-EC)

Since NSF fellows are among the top students, the Vice Chair noted that it makes sense that they might finish the program in less time, although they have no data to confirm this. (A-M).

They tend to take more courses overall, rather than getting through more quickly. (C-ME)

Career Aspirations

From our site visits we learned that both fellow and peer career aspirations frequently shifted. Many became less inclined to pursue academic careers as time passed – a shift precipitated by a number of factors, including the tight competition within the academic job market, better pay in the private sector, and especially, disillusionment with academia. Some discovered that they did not enjoy teaching, or that they did not enjoy theoretical research. Others, both men and women, were disillusioned by academic politics or by work demands and challenge of balancing an academic career and family priorities.

We were not surprised to find little difference in early career paths for 1989-1993 fellows and peers in the four disciplines. Most NSF fellows and peers in Mechanical Engineering are pursuing careers outside of academia. The majority of NSF fellows in Mathematics and Biochemistry remain still in higher education, most holding postdoctoral positions or its non-tenure track equivalent in Mathematics. Only in Economics do fellows show a higher likelihood than their peers of holding a tenure-track position. This difference, however, may be related to the fact that almost half of fellows' program peers in Economics were international students. Economics peers were more likely to be employed as an owner/partner/consultant than were fellows (23% compared to 0%) (Table A.4).

Do GF and MGF fellows experience similar educational and career success?

We looked at experiences of fellows in the two competitions, the Graduate Fellowship and the Minority Graduate Fellowship. We remind the reader that these programs do not distinguish between the ethnicity of GRF fellows, but between the competition under which they were considered. In 1993, 18% of GF fellows were members of underrepresented groups. All MGF fellows were members of underrepresented groups.

MGF fellows are somewhat less likely than GF fellows to attend and graduate from programs with reputations that are among the top five or ten institutions (NRC, 1995). Of those fellows who had graduated by 1997, 62% of GF fellows did so from programs rated as Distinguished compared to 44% of MGF fellows. This difference, of course, begins with decisions about where to apply to graduate school.

NSF fellows valued most highly the prestige that came with winning a GRF. Over two-thirds believed the award made them an asset to faculty. For some MGF fellows (as well as some WENG fellows), however, the award carried with it not just prestige, but a certain amount of stigma associated the assumption by some that the award was not merit-based.

Doctoral Completion Rates

Doctoral completion rates for MGF fellows are increasing faster than for GF fellows. Fifty-six percent of 1984-1988 MGF fellows have earned doctoral degrees in nine years, compared to 47% of the 1979-1983 MGF fellows. The gap in nine-year completion rates narrowed from 20% for 1979-1983 fellows to 13% for 1984-1988 fellows. In Physical Sciences, Biological Sciences and Behavioral Sciences, the gap shrank below ten percentage points. Only in the Social Sciences did the gap increase and completion rates decrease, a result that is similar to what we noted earlier for women fellows. (Table A.5).

This increase in MGF completion rates is driven by QG1 MGF fellows. Their doctoral completion rate within nine years rose to 62%, exceeding in nine years the rate of completion after 14 years for the 1979-1993 group and approaching the 69% completion rate for all 1984-1988 GF fellows. (Table A.6).

Time To Degree

Of those GF and MGF fellows completing doctorates in nine years, the percentage taking six years or less dropped only slightly for the 1984-1988 fellows (GF fellows: 68% to 67%; MGF fellows: 65% to 63%) (Figures 4 and 5). The modal TTD, however, shifted from fairly equal percentages completing in five and six years, to a peak at six years for both groups. Those taking more than six years were more likely to finish in just seven than were 1979-1983 fellows. These shifts in TTD, especially noticeable for MGF fellows, are related to the substantial increase in the overall percentage of fellows completing doctorates. When TTD calculations are based on a

Figure 4
Years to Doctorate for GF Fellows Completing in Nine Years

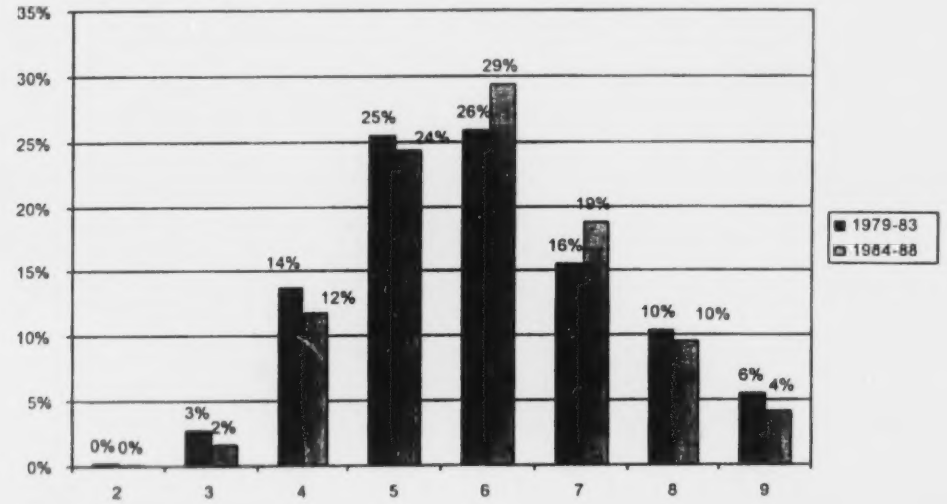
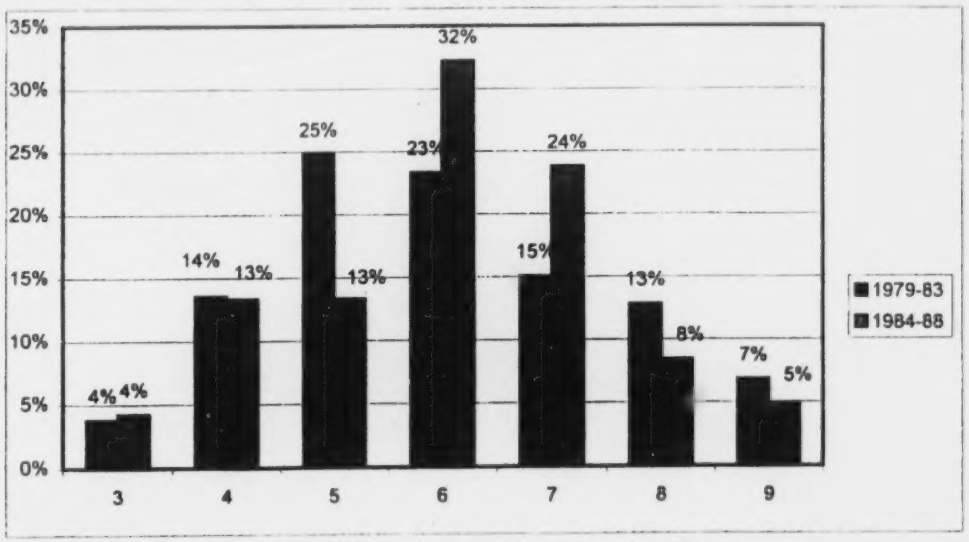


Figure 5



Years to Doctorate for MGF Fellows Completing in Nine Years

changing percentage of completers, we can infer little about the meaning to changing patterns over time. What we can say, however, is that about one third of GRF fellows are still taking more than six elapsed years to earn doctorates.

Career Aspirations

MGF fellows were less likely to respond to our survey than were GF fellows, and those who did respond were less likely to complete the section on employment (with the exception of those in Engineering). We have scant information, therefore, to assess the comparative early careers of 1989-1993 GF and MGF fellows. Looking only within Engineering, employment and professional productivity patterns are quite similar for the two groups.

Does the individual award aspect of the NSF Graduate Research Fellowship enhance the educational experience and career options of fellows?

The timing of admissions to graduate programs and awarding of the GRF results in virtually no fellowship impact on admission at the programs we visited. However, having a GRF may be an asset when changing programs, although very few take advantage of this option, or for late admission. Furthermore, once an admitted student receives GRF funding, some programs actively recruit them and enhance the fellowship with additional financial support.

The GRF award makes a discernable difference to the graduate student experience programs that rely heavily on teaching assistantships as a source of graduate student support. Reduced teaching responsibility frees NSF fellows to pursue additional coursework or explore additional research avenues, thereby broadening as well as deepening their educational experience.

We found that in departments with training grants such as Biochemistry, NSF fellows reported little differential experiences from non-fellow peers. On the other hand, fellows in departments like economics and mathematics with little sponsored research were greatly advantaged in their flexibility to choose faculty mentors and research topics. Where teaching assistantships are the primary means of graduate student support such as in mathematics, multi-year fellowships like the GRF provide very valuable time for study and individual research. Interestingly, across departments (including those with training grants) and disciplines, some NSF fellows felt that their funding enabled them to work with the newer/younger faculty who were seen

to be doing cutting-edge research but may not yet have research grants to support graduate students.

Individual fellowship funding is thought to carry with it dangers of intellectual and social isolation and reduced opportunities to teach (National Science Board, 1998). While about 20% of survey respondents identified reduced teaching opportunities as a disadvantage, less than 6% of Disciplinary fellows and MGF fellows cited other disadvantages such as lack of office space, isolation, and less opportunity to work with faculty on their research projects. WENG fellows were somewhat more likely to identify lack of office space (9%) and less opportunity to work collaboratively with other students (11%).

We found no evidence that the individual award aspect of the fellowship enhanced fellows' career options, although there was some speculation that having the GRF was an asset in getting postdoctoral fellowships or research funding. The prestige factor associated with having won a GRF fellowship was cited as being beneficial to graduates in their job search.

The broadest finding from our study, but one that it is important to confirm, is that the GRF program continues to play a distinguished and vital role in graduate education. Since its inception in 1952, other fellowship programs have emerged, some conferring equivalent stature on their recipients, or providing higher levels of funding, but none approach the scope or size of the GRF program. With more than 8000 applicants and up to 1000 new fellowships awarded each year, the GRF program reaches all of the fields supported by the National Science Foundation by identifying and supporting those students with the potential to become leaders among the next generation of scientists and engineers.

The value of the GRF program stems not only from the direct financial support available to fellows, but also from the prestige that success in this national competition confers on NSF fellows and the program's impact on graduate programs. With one major exception – a Vice President for Research [C] who was concerned that "this fellowship program has less cachet than before" - senior university administrators had very high praise for the GRF program and its contributions to graduate education.

> A former NSF GRF fellow himself, the Vice-Provost is clear about the value of the program and its significance to [Institution D]: "I can't say enough about the importance of the program. If I had to create a list of the ways which Federal

government is spending its money on research, or indeed how the Foundation is spending its money on research, the NSF fellowship program in my way of thinking would be at the top." (D)

"It is one of the most prestigious [fellowship programs]. The money is not so great, but it says a lot about our institution that they come here." "It is certainly one of the premiere programs. The honor to the student would be hard to state - how prestigious it is to the student." "It has importance to the graduate enterprise nationally.... More top students enhance the quality of graduate education." "It is of immeasurable value and enriches the enterprise." (E)

"[Eliminating GRF] would send a signal to the community that would be very confusing and perhaps discouraging for graduate study.... I think that this is a uniquely successful program. A national competition and students can take the funds anywhere they want. It gives them a degree of choice, makes them very eligible to be recruited by top graduate programs." (A-M)

CONCLUSIONS

In response to the three specific research questions, we found a positive effect for female fellows and recipients of MGF fellowships, suggesting that the 'signaling effect' both to the individual and their department is important. MGF recipients showed marked improvement since the last study (Baker, 1995) in closing the gap for completion rates in comparison to GF recipients. The importance of the individual award aspects of the fellowship varied by discipline and by the other sources of graduate funding support available in individual departments.

The multi-methods approach of this study helps to demonstrate the importance of disaggregating the effects of financial aid for graduate students. The impact of particular types of funding will be quite different from graduate program to graduate program and the decentralized organizational structure of the graduate education system in the U. S. means that change will occur, literally one program at a time. Federally-funded training grants are a potent tool to stimulate the 'reshaping of graduate education,' but fellowship support continues to play a key role for individual students – especially women and underrepresented groups – for whom they provide an additional component of recognition.

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Table A.1
Completion Rates of GRF Fellows and Non-Fellows by Discipline Group

	I: EMP			II: BLS			III: B&S			IV: Total		
	GRF Fellows		QG 2-Non	GRF Fellows		QG 2-Non	GRF Fellows		QG 2-Non	GRF Fellows		QG 2-Non
	QG 1	QG2	Award	QG 1	QG2	Award	QG 1	QG2	Award	QG 1	QG2	Award
Graduated within 4 years of award												
1979-83	14.2%	11.8%	9.3%	6.2%	8.1%	9.2%	14.0%	9.5%	9.9%	11.6%	10.2%	9.4%
1984-88	10.6%	11.5%	8.4%	8.4%	5.6%	10.1%	10.2%	7.1%	9.0%	9.9%	8.8%	8.9%
1989-93	7.6%	8.1%	7.8%	5.6%	4.0%	4.9%	10.0%	7.6%	8.1%	7.7%	7.0%	7.2%
Graduated within 9 years of award												
1979-83	71.0%	63.2%	57.6%	68.2%	65.2%	63.1%	58.2%	52.9%	50.3%	67.1%	61.5%	57.4%
1984-88	69.2%	65.2%	54.7%	74.8%	73.6%	70.4%	62.4%	54.3%	48.0%	69.5%	65.3%	57.5%
Graduated within 14 years or more of award												
1979-83	75.4%	67.0%	61.6%	72.7%	69.9%	66.3%	64.6%	61.6%	60.9%	71.9%	66.7%	62.9%

EMP = Engineering, Mathematics & Computer Science, Physical Sciences

BLS = Biological and Life Sciences

B&S = Behavioral and Social Sciences

Table A.2
Nine Year Doctoral Completion Rates by Gender and Discipline

	Women Fellows		Men Fellows		Difference
	Number	% Completed	Number	% Completed	
Engineering					
1979-1983	44	55%	289	62%	-9%
1984-1988	103	62%	386	65%	-3%
Comp Sci/Math					
1979-1983	35	40%	204	61%	-21%
1984-1988	49	53%	245	57%	-4%
Physical Sciences					
1979-1983	110	66%	394	78%	-12%
1984-1988	115	71%	245	78%	-7%
Biological Sciences					
1979-1983	340	67%	416	66%	+1%
1984-1988	375	74%	388	74%	Same
Social Sciences					
1979-1983	156	42%	234	56%	-14%
1984-1988	166	46%	225	58%	-12%
Behavioral Sciences					
1979-1983	107	66%	67	69%	-3%
1984-1988	109	74%	72	71%	+3%
Total					
1979-1983	792	60%	1604	66%	-6%
1984-1988	917	66%	1720	68%	-2%

Table A.3

Percent of 1979-1988 NSF Fellows, Non-Awardees and Fellowship Decliners completing Doctoral Study by 1997 by Gender and Quality Group

		Men				Women				Total			
		NSF Fellows		Q2	Fellowship	NSF Fellows		Q2	Fellowship	NSF Fellows		Q2	Fellowship
		Q1	Q2	Non-Awd	Decliners	Q1	Q2	Non-Awd	Decliners	Q1	Q2	Non-Awd	Decliners
Math	**% Completed**	**66.4**	**69.0**	**59.6**	**53.8**	**63.6**	**56.2**	**71.4**	**42.9**	**66.3**	**65.5**	**60.4**	**51.5**
	Total Number	*155*	*87*	*104*	*26*	*11*	*32*	*7*	*7*	*166*	*119*	*111*	*33*
Comp Science	**% Completed**	**57.1**	**48.0**	**50**	**52.2**	**41.7**	**37.9**	**75.0**	**23.1**	**55.6**	**45.8**	**51.1**	**45.8**
	Total Number	*105*	*102*	*86*	*46*	*12*	*29*	*4*	*13*	*117*	*131*	*90*	*59*
Physical Sci	**% Completed**	**80.4**	**81.2**	**71.6**	**63.8**	**69.7**	**71.1**	**52.6**	**40.7**	**78.9**	**78.8**	**70.7**	**57.3**
	Total Number	*474*	*324*	*370*	*69*	*76*	*149*	*19*	*27*	*550*	*473*	*389*	*96*
Engineering	**% Completed**	**71.4**	**60.3**	**47.3**	**47.7**	**71.4**	**57.7**	**57.1**	**45.7**	**71.4**	**59.6**	**47.9**	**47.4**
	Total Number	*388*	*287*	*317*	*155*	*49*	*97*	*21*	*35*	*437*	*384*	*338*	*190*
EMP Total	**% Completed**	**73.2**	**68.1**	**59.3**	**52.7**	**67.6**	**62.2**	**58.8**	**40.2**	**72.5**	**66.5**	**59.3**	**50**
	Total Number	*1122*	*800*	*877*	*296*	*148*	*307*	*51*	*82*	*1270*	*1107*	*928*	*378*
Biol Life Sciences	**% Completed**	**73.8**	**72.7**	**74.1**	**63.6**	**77.8**	**72.5**	**55.1**	**40.4**	**75.2**	**72.6**	**69.1**	**52.3**
	Total Number	*522*	*282*	*406*	*55*	*293*	*422*	*147*	*52*	*815*	*704*	*553*	*107*
Social Sciences	**% Completed**	**65.5**	**57.8**	**54.0**	**34.4**	**47.6**	**55.1**	**46.5**	**22.6**	**60.1**	**56.4**	**52.3**	**28.6**
	Total Number	*293*	*166*	*237*	*32*	*126*	*196*	*71*	*31*	*419*	*362*	*308*	*63*
Behavioral Sciences	**% Completed**	**71.6**	**68.6**	**77.5**	**22.2**	**81.1**	**66.4**	**59.3**	**36.4**	**76.8**	**67.1**	**69.6**	**30**
	Total Number	*88*	*51*	*71*	*9*	*106*	*110*	*54*	*11*	*194*	*161*	*125*	*20*
Soc/Beh Sci Total	**% Completed**	**66.9**	**60.4**	**59.4**	**31.7**	**62.9**	**59.2**	**52.0**	**26.2**	**65.4**	**59.7**	**57.2**	**28.9**
	Total Number	*381*	*217*	*308*	*41*	*232*	*306*	*125*	*42*	*613*	*523*	*433*	*83*
All Fields	**% Completed**	***72.1***	***67.8***	***63.1***	***52***	***70.4***	***65.5***	***54.5***	***36.9***	***71.7***	***66.8***	***61.6***	**47.4**
	Total Number	*2025*	*1299*	*1591*	*392*	*673*	*1035*	*323*	*176*	*2698*	*2334*	*1914*	*568*

Table A.4
Type of Position Held by Disciplinary Fellows and Peers in January 1999

	Mechanical Engineering		Mathematics		Biochemistry		Economics	
	Peers	Fellows	Peers	Fellows	Peers	Fellows	Peers	Fellows
Number responding	22	30	26	28	22	13	31	40
% of those expected to respond	69%	71%	58%	74%	61%	59%	70%	78%
Postdoctoral fellow		(2)	12%	36%	50%	54%		
Non-tenure track faculty		(1)	(1)	14%			(1)	
Tenure-track faculty	14%	(2)	19%	11%	(2)	(1)	36%	60%
Tenured faculty								(1)
Researcher (not faculty)	(2)	(1)			(1)		(1)	(1)
Administrator/manager								
Clerical/support								
Other	(1)	(1)			14%			
Total, higher education	27%	23%	36%	61%	77%	62%	43%	65%
Owner/partner		(1)				(2)	10%	
Administrator/manager	(2)	(2)					(1)	
Professional	46%	57%	38%	32%	18%	(2)	29%	32%
Those with masters	50%	75%						
Those with doctorate	(1)	40%						
Clerical/support								
Consultant	(2)	(1)					13%	
Other	(1)		(2)					2.5
Total, All other	68%	70%	48%	32%	18%	31%	57%	35%
Blank	(1)	(2)	19%	(2)	(1)	(2)	(1)	0
Probability of difference of employment in Higher Ed.	0.9		0.18		0.6		0.07	
Probability of difference in type of position held	0.73		0.10		0.4		0.05	

Table A.5
Nine Year Doctoral Completion Rates by Fellowship Type and Discipline

	GF Fellows		MGF Fellows		Difference
	Number	% Completed	Number	% Completed	
Engineering					
1979-1983	307	63%	26	35%	-28%
1984-1988	438	66%	51	49%	-17%
Comp Sci/Math					
1979-1983	221	59%	18	70%	MGF<20
1984-1988	278	58%	16	60%	***MGF<20***
Physical Sciences					
1979-1983	464	77%	40	58%	-19%
1984-1988	487	77%	32	69%	-8%
Biological Sciences					
1979-1983	668	69%	88	49%	-20%
1984-1988	694	75%	69	70%	-5%
Social Sciences					
1979-1983	319	52%	71	42%	-10%
1984-1988	333	55%	58	38%	-17%
Behavioral Sciences					
1979-1983	132	72%	42	52%	-20%
1984-1988	151	74%	30	67%	-7%
Total					
1979-1983	2111	67%	285	47%	-20%
1984-1988	2381	70%	256	57%	-13%

Table A.6

Percent of 1979-1988 NSF Fellows, Non-Awardees and decliners completing Doctorate by 1997 by Program Category and Quality Group of Fellows

		Graduate Fellows				Minority Graduate Fellows				Total			
		NSF Fellows		QG2	Fellowship	NSF Fellows		QG2 Fellowship		NSF Fellows		QG2 Fellowship	
		QG1	QG2	Non-Awd	Decliners	QG1	QG2	Non-Awd	Decliners	QG1	QG2	Non-Awd	Decliners
Math	**% Completed**	**66.9**	**67.3**	**62.1**	**51.8**	**60.0**	**44.4**	**37.5**	**50.0**	**66.3**	**65.5**	**60.4**	**51.5**
	Total Number	*151*	*110*	*103*	*27*	*15*	*9*	*8*	*6*	*166*	*119*	*111*	*33*
Comp Science	**% Completed**	**57.5**	**47.2**	**51.2**	**50.0**	**0**	**16.7**	**50.0**	**22.2**	**55.6**	**45.8**	**51.1**	**45.8**
	Total Number	*113*	*125*	*84*	*50*	*4*	*6*	*6*	*9*	*117*	*131*	*90*	*59*
Physical Sci	**% Completed**	**79.3**	**79.0**	**71.7**	**58.0**	**73.7**	**64.7**	**56.0**	**50.0**	**78.9**	**78.8**	**70.7**	**57.3**
	Total Number	*1220*	*439*	*364*	*88*	*38*	*34*	*25*	*8*	*550*	*473*	*389*	*96*
Engineering	**% Completed**	**73.4**	**61.6**	**49.7**	**49.7**	**50.0**	**42.1**	**31.2**	**33.3**	**71.4**	**59.6**	**47.9**	**47.4**
	Total Number	*399*	*346*	*306*	*163*	*38*	*38*	*32*	*27*	*437*	*384*	*338*	*190*
EMP Total	**% Completed**	**73.6**	**67.9**	**60.7**	**52.1**	**61.8**	**49.4**	**42.2**	**36.0**	**72.5**	**66.5**	**59.3**	**50.0**
	Total Number	*1175*	*1020*	*857*	*328*	*272*	*87*	*71*	*50*	*1270*	*1107*	*928*	*378*
Biol/Life Sciences	**% Completed**	**76**	**74.4**	**72.1**	**54.7**	**68.3**	**57.3**	**45.2**	**33.3**	**75.2**	**72.6**	**69.1**	**52.3**
	Total Number	*733*	*629*	*491*	*95*	*82*	*75*	*62*	*12*	*815*	*704*	*553*	*107*
Social Sciences	**% Completed**	**61.7**	**60.6**	**55.7**	**33.3**	**50.8**	**38.6**	**31.8**	**16.7**	**60.1**	**56.4**	**52.3**	**28.6**
	Total Number	*360*	*292*	*264*	*45*	*59*	*70*	*44*	*18*	*419*	*362*	*308*	*63*
Behavioral Sciences	**% Completed**	**77.8**	**71.2**	**77.9**	**41.7**	**72.2**	**52.8**	**28.6**	**12.5**	**76.8**	**67.1**	**69.6**	**30.0**
	Total Number	*158*	*125*	*104*	*12*	*36*	*36*	*21*	*8*	*194*	*161*	*125*	*20*
Soc/Beh. Sci Total	**% Completed**	**66.6**	**63.8**	**62.0**	**35.1**	**58.9**	**43.4**	**30.8**	**15.4**	**65.4**	**59.7**	**57.2**	**28.9**
	Total Number	*518*	*417*	*368*	*57*	*95*	*106*	*65*	*26*	*613*	*523*	*433*	*83*
All Fields	**% Completed**	**72.8**	**69.1**	**64.2**	**50.6**	**61.8**	**49.2**	**39.4**	**29.5**	**71.7**	**66.8**	**61.6**	**47.4**
	Total Number	*2426*	*2066*	*1716*	*480*	*272*	*268*	*198*	*88*	*2698*	*2334*	*1914*	*568*

Table A.7
Advantages of the NSF Graduate Research Fellowship

	Disciplinary Fellows	WENG Fellows	MGF Fellows
	Percentage responding yes		
Advantages			
Full-time study allowed for a quicker start in program	56%	47%	54%
Will/did shorten my time to degree completion	36%	34%	31%
Reputation among faculty as a good student	67%	76%	62%
Perception by peers as being a good student	50%	34%	49%
Better opportunity to choose research projects	34%	59%	51%
I was an asset to faculty to work on their projects because I had my own funding	36%	73%	58%
Having it on my CV helped/will help in job search	67%	57%	69%
Financial support (stipend)	81%	87%	89%
Tuition assistance (cost of ed. Allowance)	63%	70%	65%
Other	7%	14%	8%
Disadvantages			
No office space provided by department	3%	9%	2% (1)
Less opportunity to work with faculty on their research projects (RA)	5%	6%	6%
Less opportunity to work collaboratively with other students	4%	11%	6%
Less opportunity to teach (TA)	21%	16%	20%
Isolated from other students in program	5%	3%	5%
Could not live on stipend alone	8%	14%	17%
Support only lasted 3 years	44%	31%	48%
Other	12%	13%	11%
Did institution offer financial support after fellowship ended?			
Yes	74%	60%	66%
No	8%	7%	11%
Not applicable	17%	29%	23%

Fellowship Effects in Graduate Education:

Evaluating the National Science Foundation's Graduate Research Fellowship Program

Sharon S. Goldsmith and Jennifer B. Presley

ASHE – San Antonio
November 20, 1999

WestEd

NSF Graduate Research Fellowship Program

- **Program Attributes**
- **Prior Studies**
- **Program Evaluation**

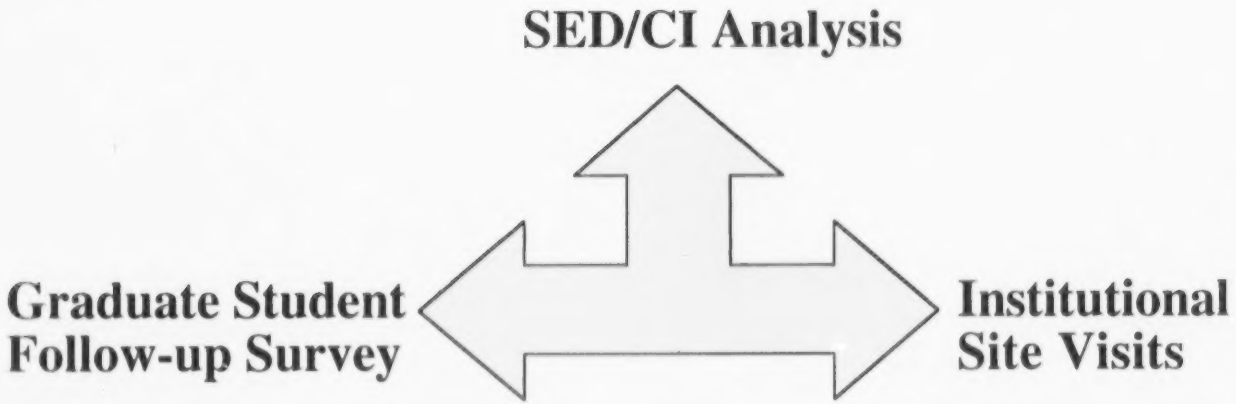
Research Questions

1. **Do recent NSF fellows show evidence of more timely completion of degree and early career success?**

2. **Do Graduate Fellows and Minority Graduate Fellows experience similar educational and career success?**

3. **Does the individual award aspect of the NSF Graduate Research Fellowship enhance the educational experience and career options of fellows?**

Methodology



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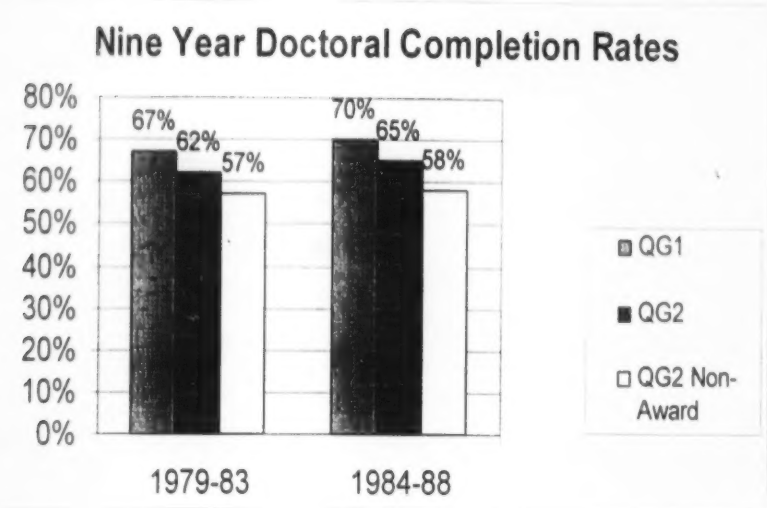
Doctoral Completion Rates for GRF Fellows

Five Year Cohort	Percent completing Ph.D. in 4 years or less	Percent completing Ph.D. in 9 years or less
1979-1983	11%	64%
1984-1988	9%	68%
1989-1993	6%	N/A

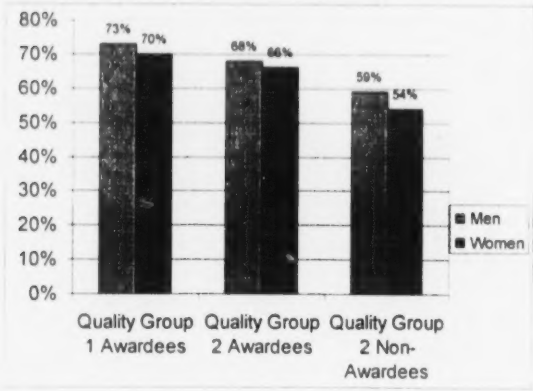


9-Year Completion Rates of GRF Fellows and Non-Fellows by Discipline Group

Cohort	I: EMP			II: BLS			III: B&S		
	GRF Fellows		QG 2-Non Award	GRF Fellows		QG 2-Non Award	GRF Fellows		QG 2-Non Awar
	QG 1	QG2		QG 1	QG2		QG 1	QG2	
1979-83	71%	63%	58%	68%	65%	63%	58%	53%	50%
1984-88	69%	65%	55%	75%	74%	70%	62%	54%	48%

EMP = Engineering, Mathematics and Physical Sciences
BLS = Biological and Life Sciences
B&S = Behavioral and Social Sciences

Doctoral Degree Completion Rates by 1997 for 1979-1988 Men and Women Fellows



Sector of Employment for 1989-1993 Fellows and Program Peers in January 1999

		% in higher education (T/TR)	% in other organizations
echanical	Peers	27% (14%)	68%
ıgineering	Fellows	23% (*)	70%
athematics	Peers	43% (23%)	57%
f those with known responses)	Fellows	61% (11%)	32%
ochemistry	Peers	77% (*)	18%
	Fellows	62% (*)	31%
:onomics	Peers	43% (36%)	65%
	Fellows	57% (60%)	35%

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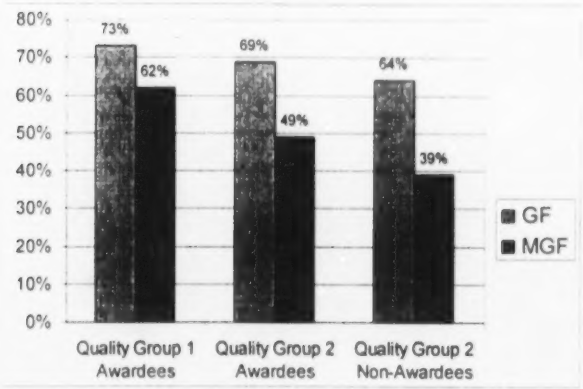
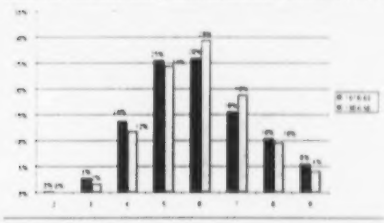
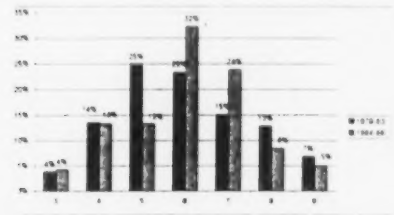
Doctoral Degree Completion Rates by 1997 for
1979-1988
GF and MGF Fellows



Years to Doctorate for GF Fellows Completing in Nine Years



Years to Doctorate for MGF Fellows Completing in Nine Years



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Fellowship Effects

- Timing of awards eliminates possible impact on admission decisions - may incluence enrollment choice of fellows.
- Individual award aspect an advantage for
  - changing programs
  - choosing (and being chosen by) advisors
  - reducing teaching responsibilities - more time for research
- Impact varies by discipline and department's array of funding.

Do fellows experience disadvantages?

- 20% of survey respondents saw reduced teaching as a disadvantagae
- Only 6% cited other disadvantages, such as lack of office space, isolation and less opportunity to work with faculty on research projects.

Career Options

- We fond no evidence that the individual award aspect of the fellowship enhanced career options
- The prestige factor of the award was thought to benefit graduates in the job/postdoctoral search.

Conclusions

- The stature of the award benefits fellows - especially women and MGF fellows
- Fellowship effects vary from graduate program to graduate program, and from discipline to discipline.
- The multi-methods approach of this study helps to demonstrate the importance of disaggregating the effects of financial aid for graduate students.